

NTNU

Deep Water Drilling - Well Completion and Well Intervention

Trends and needs for new technology

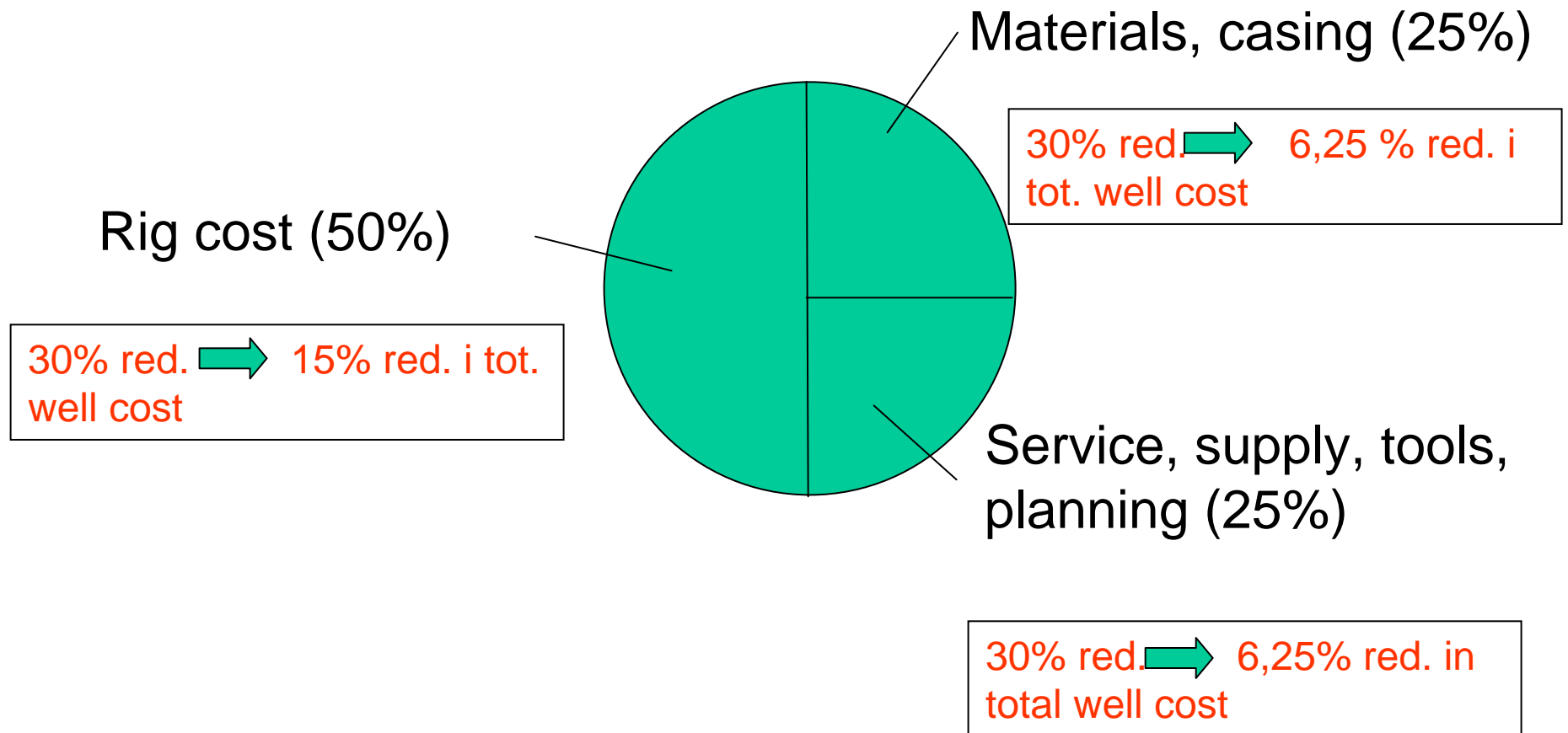
21.02.2006 Sigbjørn Sangesland

Cost effective drilling (From OG 21)

Goal:

Development of technology for exploration, production and side-track drilling at half the cost

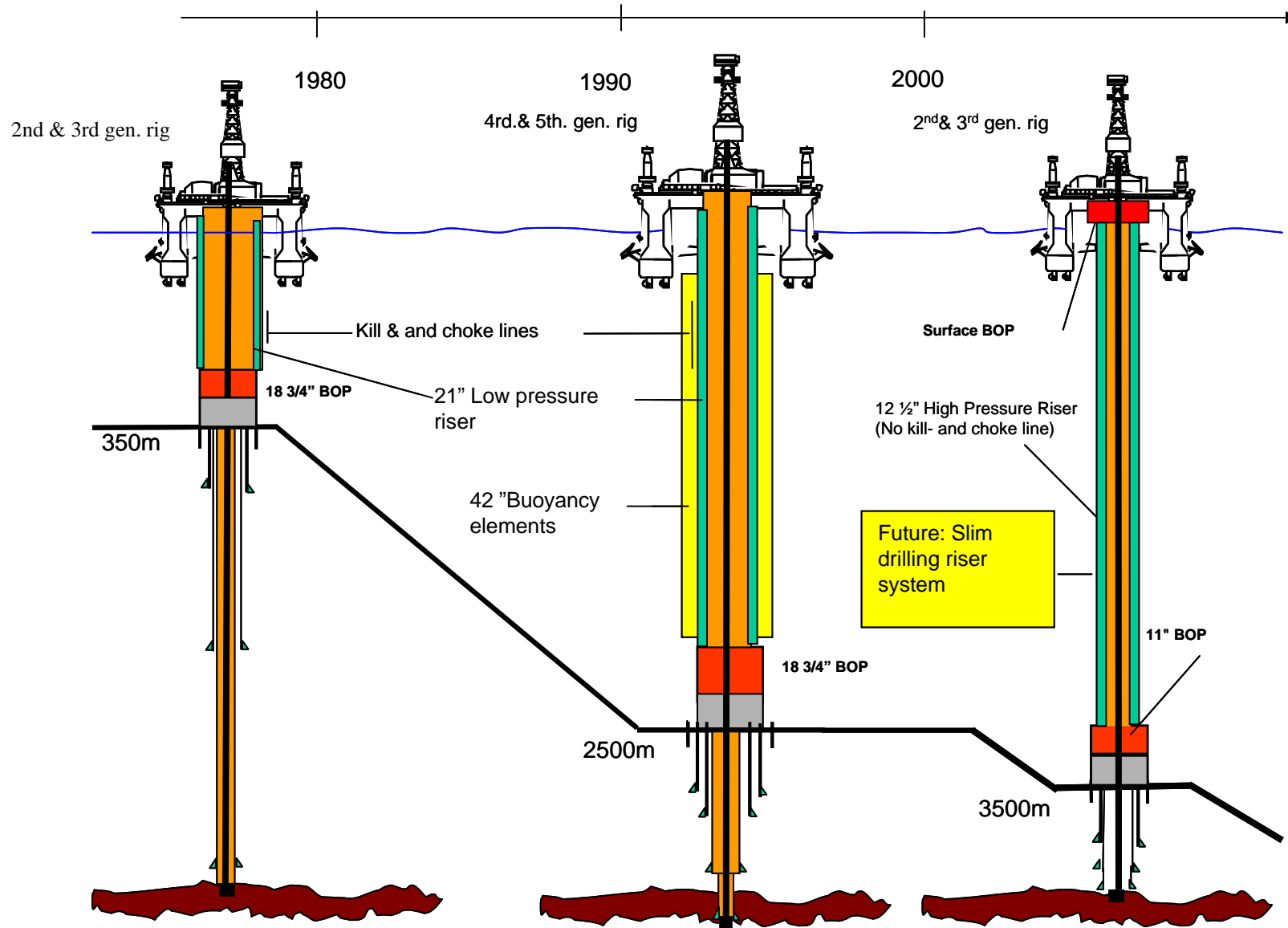
Well Cost Distribution



The main contribution to reduced well costs is reduced rig cost

$$\text{Rig cost} = \text{Rig day rate} \times \text{no of days}$$

Trends in Subsea Drilling



Means to reduce drilling costs

- Reduced size of riser and BOP
- Technology for slim hole drilling
 - Expandable casing technology
 - Managed pressure drilling” (MPD)
- Online communication (“Electric” drillstring, etc.)

Deep Water drilling challenges

What is the real/main problem?

Soft sediments with low formation strengths.

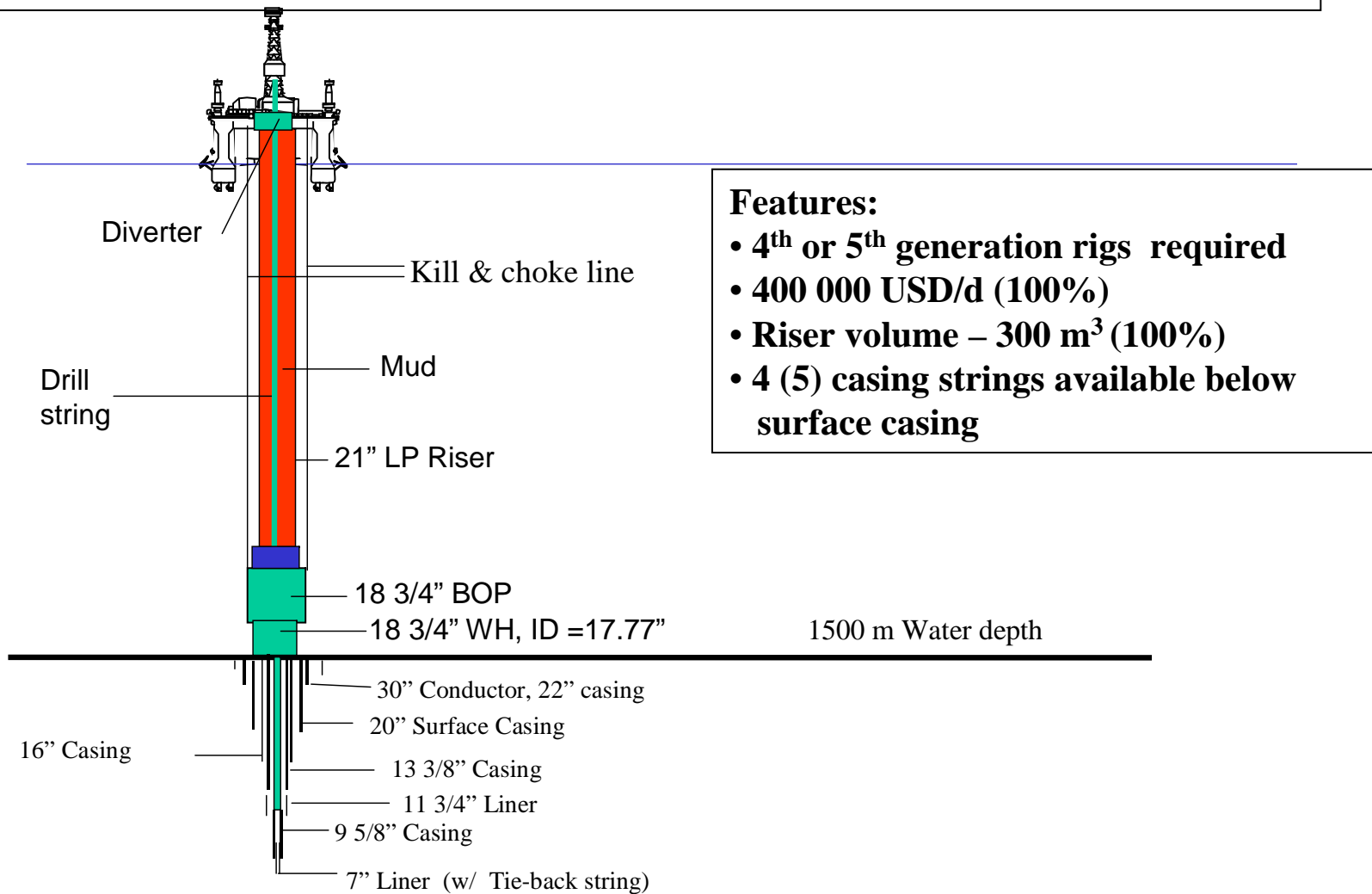


- Low margin between pore pressure and fracture pressure

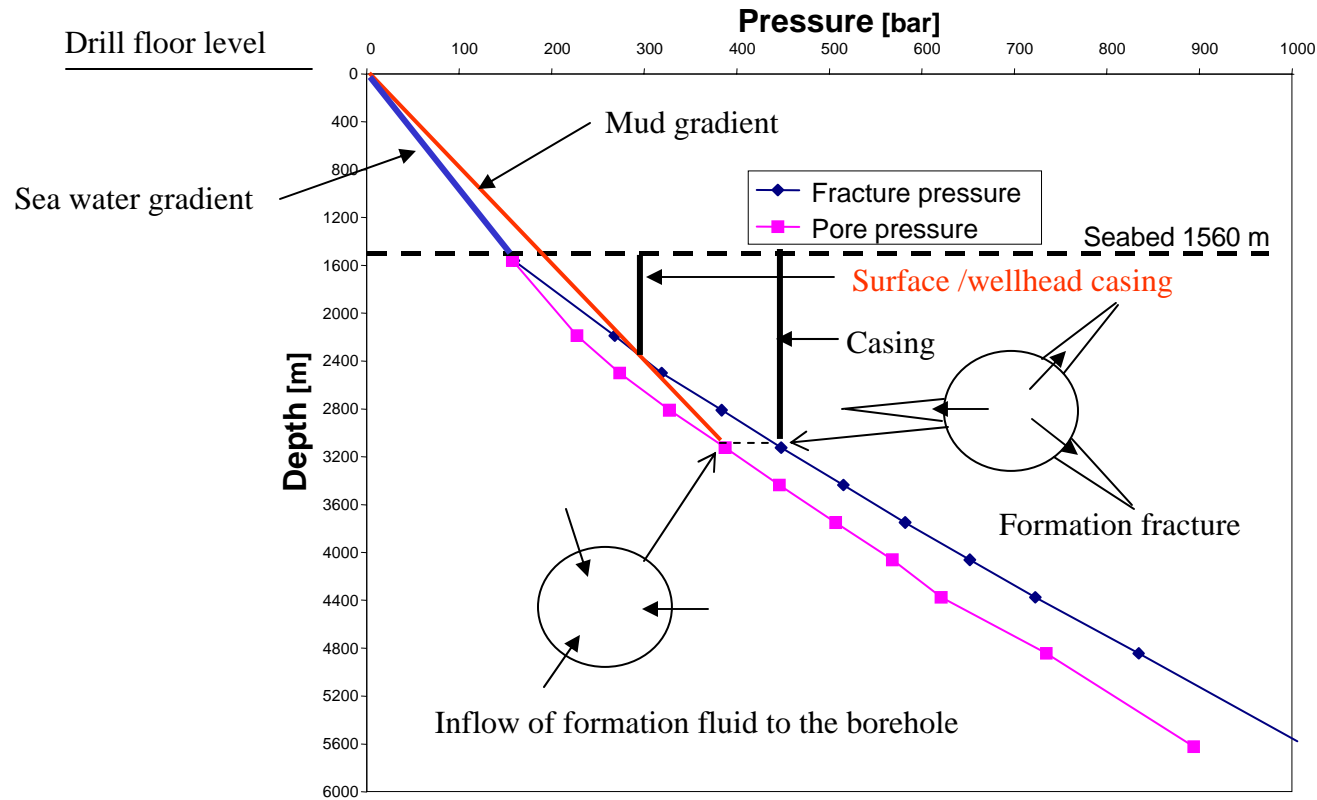
→ Many casing strings needed

- Well killing is more difficult due to high pressure drop in kill- and choke lines
 - Time consuming riser/BOP handling
 - Large volum of drilling fluid in the riser, and heavy loads
- Large and costly drilling vessel needed

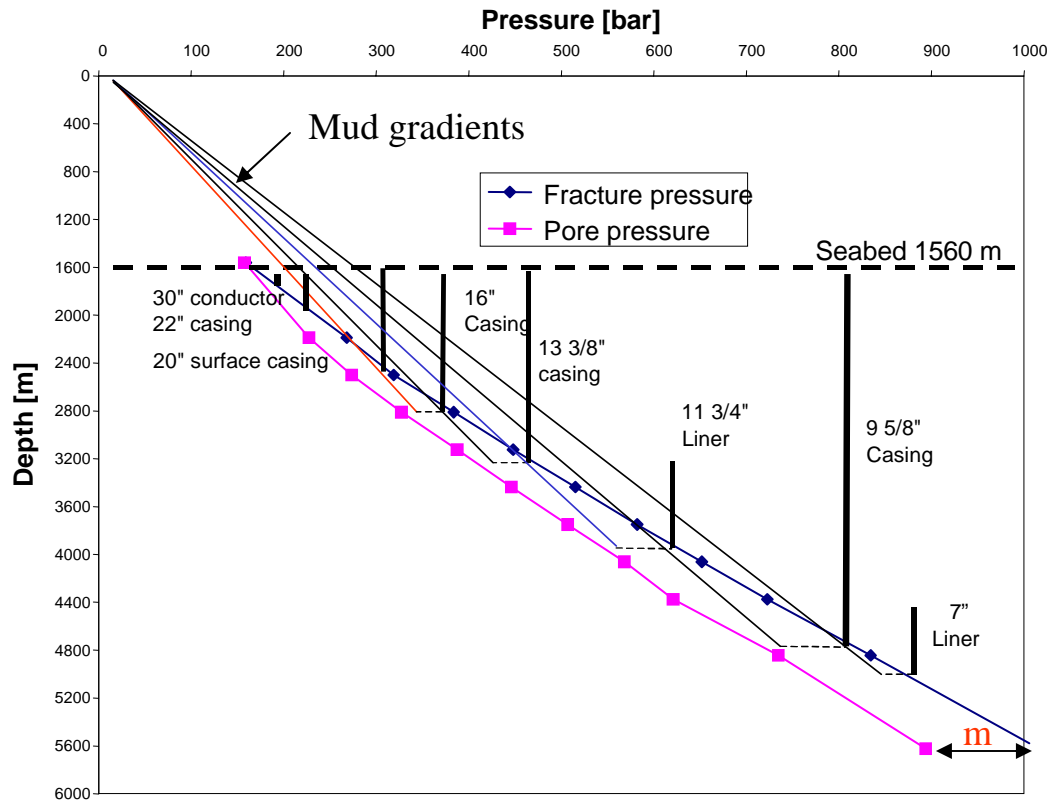
18 3/4" wellhead and 21" drilling riser (Base Case - 100 %)



Typical pore pressure and formation fracture grad. for geo-pressured areas in Gulf of Mexico



Typical casing program using a 18 3/4" wellhead system

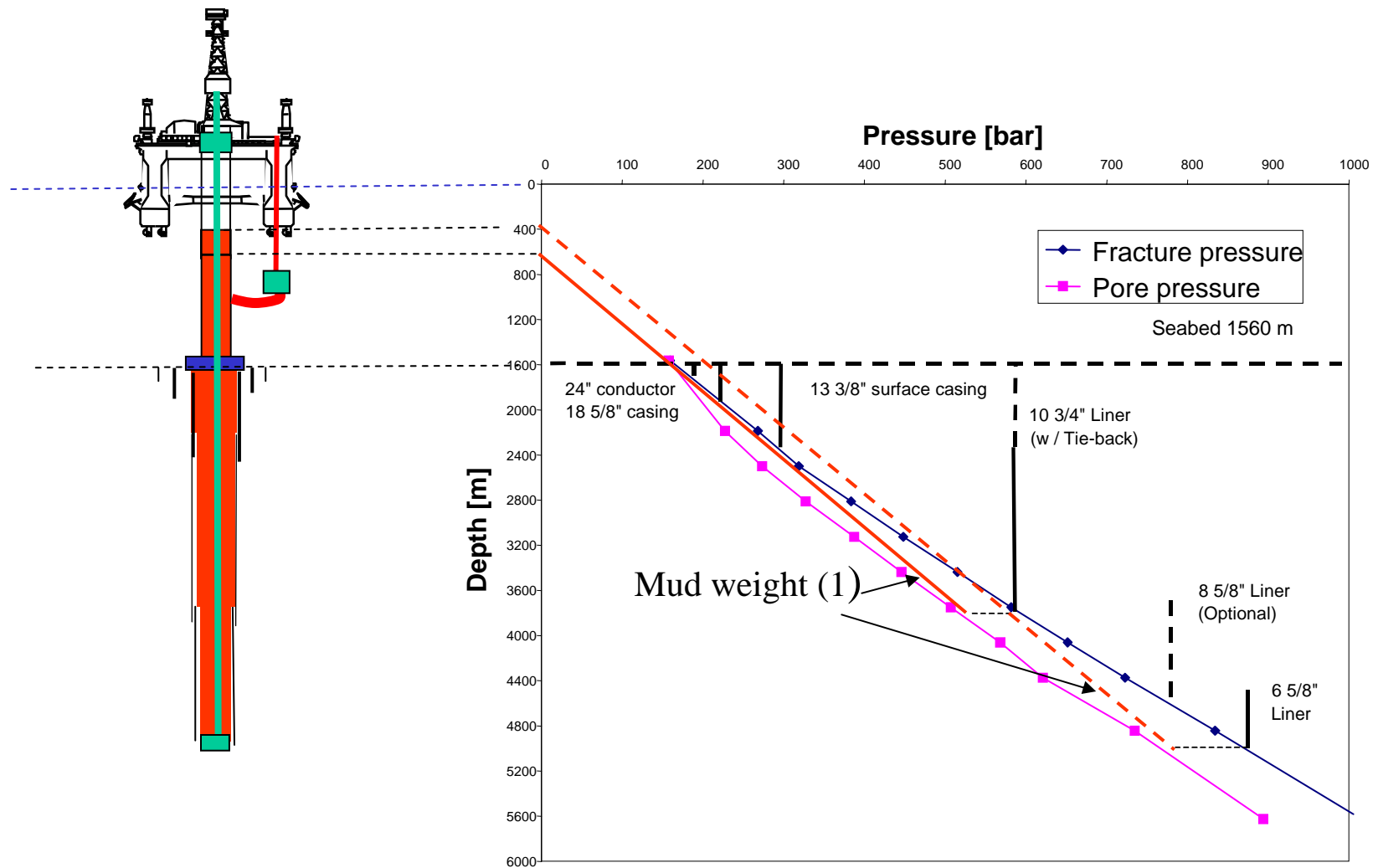


- Max. 5 casing points below surface casing (7" liner)
- Increasing water depth reduces the margin (**m**) between pore pressure and fracture pressure gradients → more casing points needed.

Alternative drilling methods

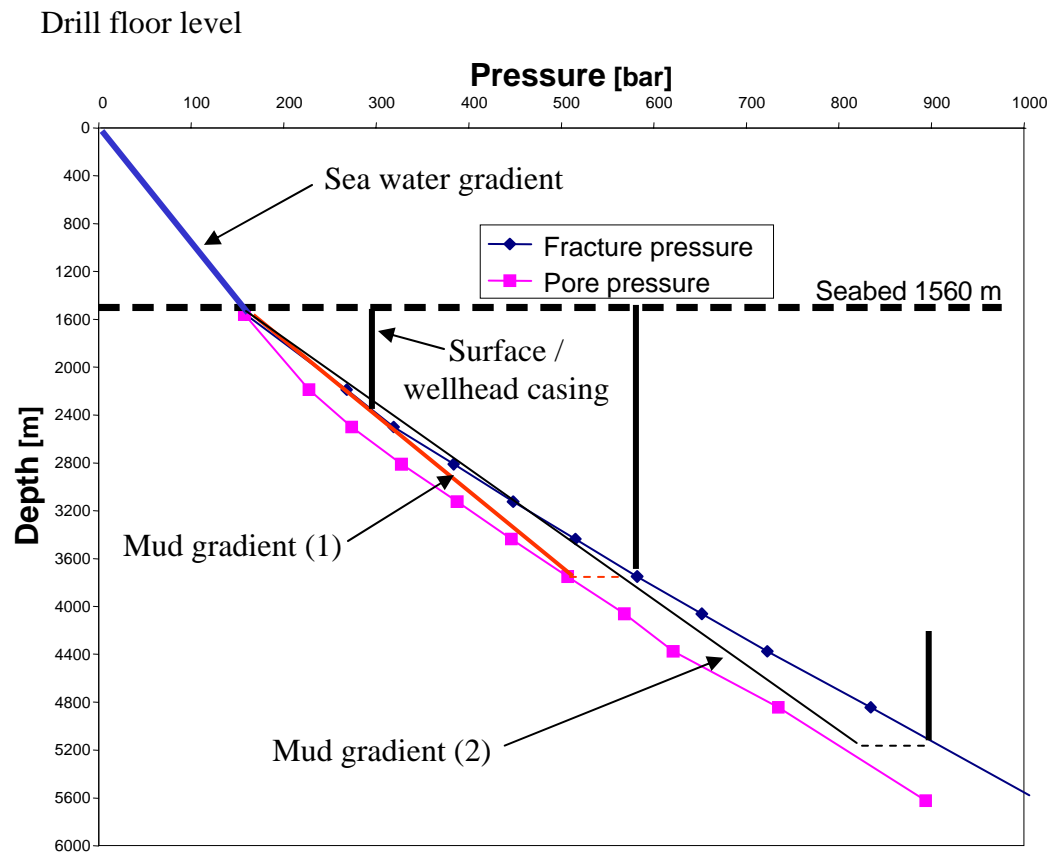
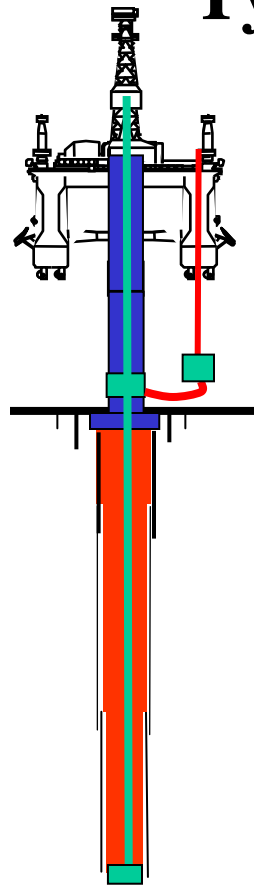
1. Managed pressure drilling” (MPD)
 - Single Gradient Drilling system –
LRRS w/ HP riser
 - Dual Gradient Drilling system –
Subsea pump w/ LP riser
2. Expandable casing

Casing program using LRRS and 13 5/8" Wellhead



- Only 2 casing points below surface casing needed (7" liner)

Typical mud grad. for Dual Grad. Drilling System



- Only 2 casing points below surface casing needed (7" liner)

A schematic diagram of a drilling rig. A central vertical wellbore is shown, colored red and green. The rig structure is black, with a derrick at the top. A blue line indicates the ground level. A diagonal line points from the text 'Drilling' to the wellbore.

5" Drill string

- 12" ID Riser

11" BOP

- 16" Conductor

13 3/8" Surface csg.

11 3/4" Pre-installed liner

9 5/8" Expandable Liner (ID = 9,878")

9 5/8" Expandable Liner (ID = 9,878")

9 5/8" liner set in 11 3/4" surface casing

(for pressure integrity)

- 7" Liner

surface casing (expandable casing allows mono-bore diameter hole, and therefore more casing strings can be used if required)

Wellhead / X-Mas tree for "slim well"

11" HX-Mas tree

– 7" Tie-back string w / 7" TRSCSSV

Subsea Well Intervention

The reservoir recovery rate in subsea wells is typical 10 – 15% lower compared to platform completed wells. The main reasons are:

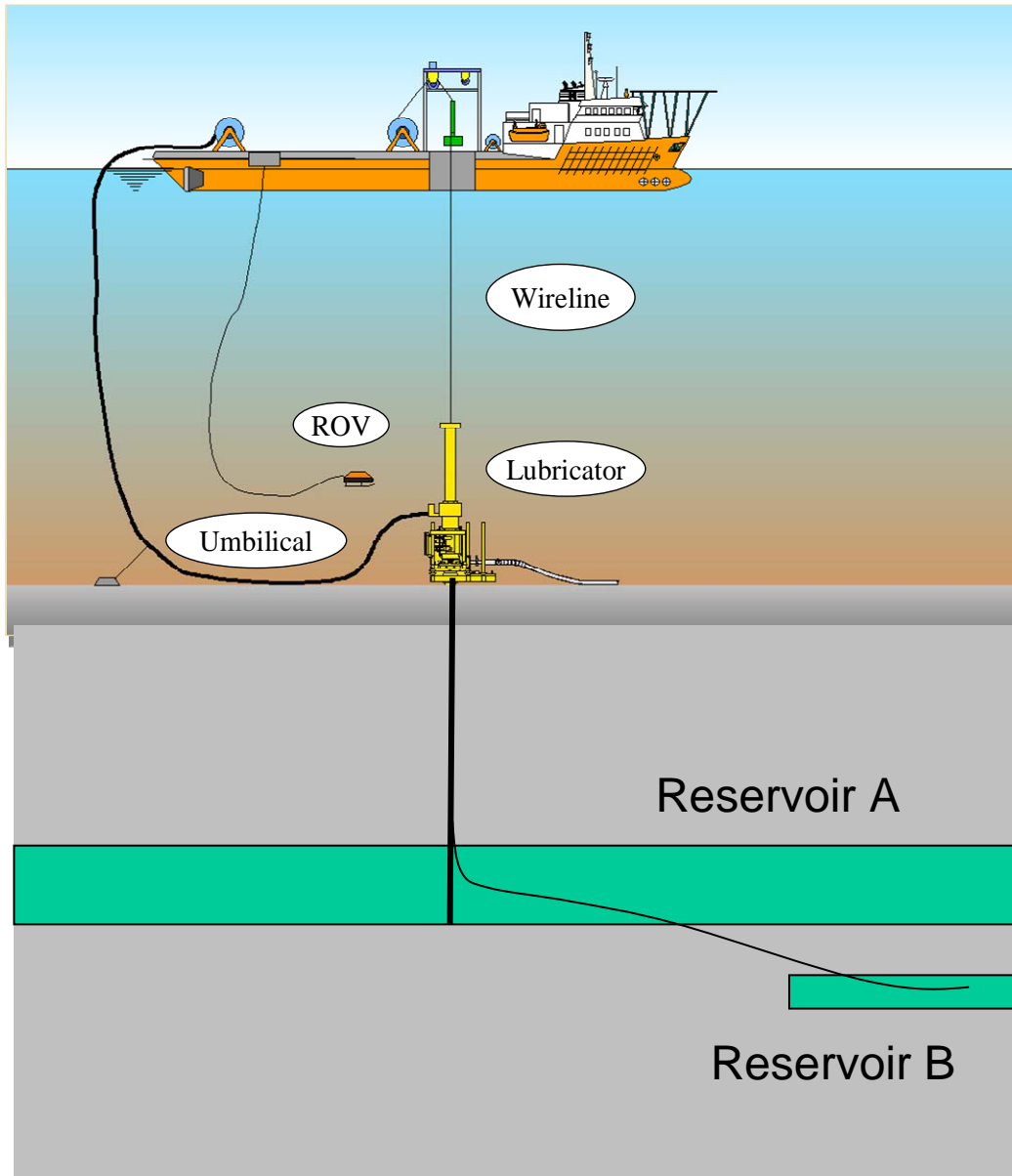
- **Subsea well intervention is more costly**
- **Less drainage points in the reservoir**

(1% increase in recovery from the NCS is equal to 250 billion NOK).

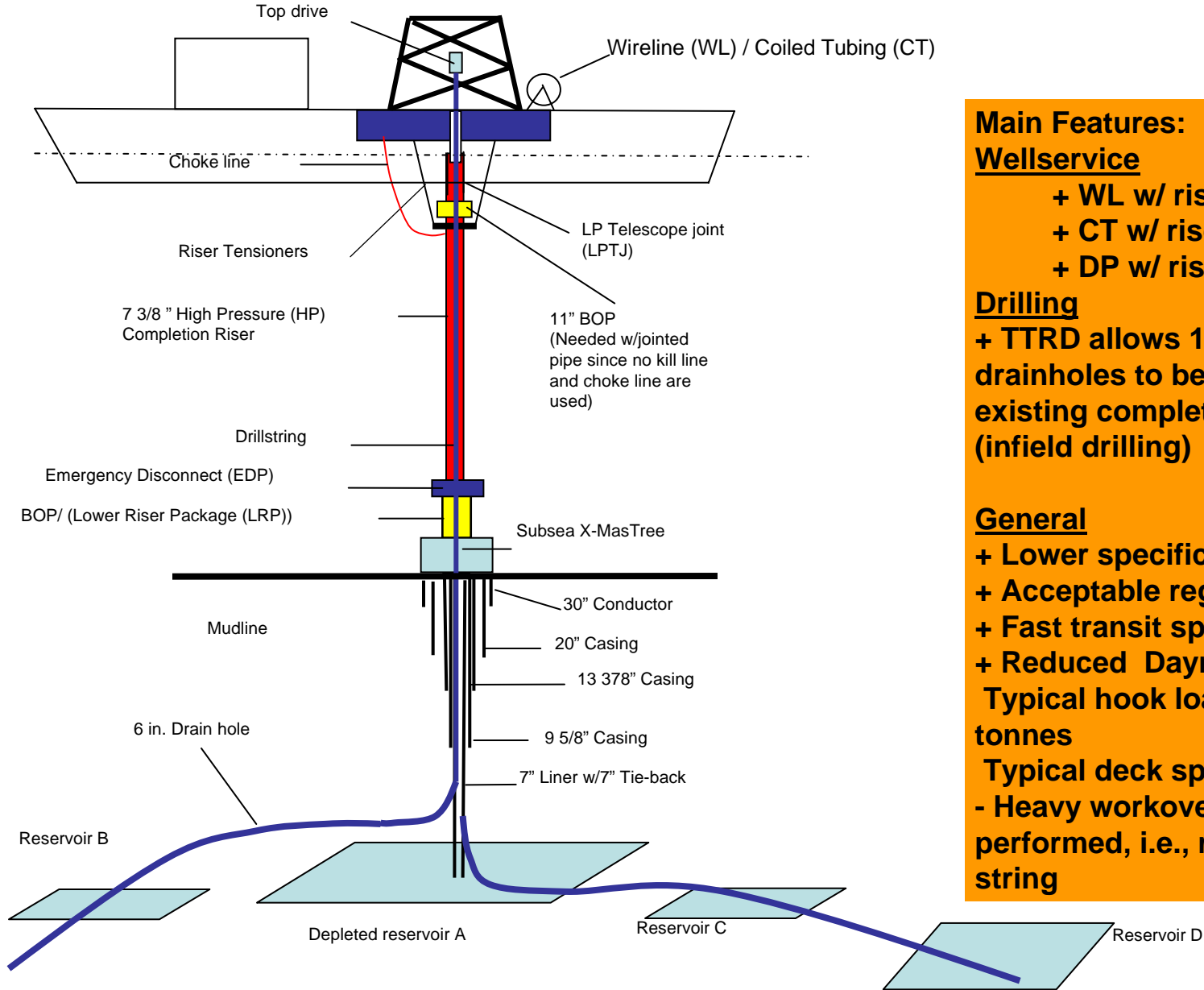
Riser less well intervention system

Typical well intervention tasks:

- Production logging
- Replacement of DHSV
- Run down hole gauge system
- Others



TTRD system for "in-field drilling" in Subsea Wells



Main Features:

Wellservice

- + WL w/ riser or riserless
- + CT w/ riser (riserless, future)
- + DP w/ riser (2 7/8" to 3 1/2")

Drilling

- + TTRD allows 1500 m + long 5-6" drainholes to be drilled through existing completion (infield drilling)

General

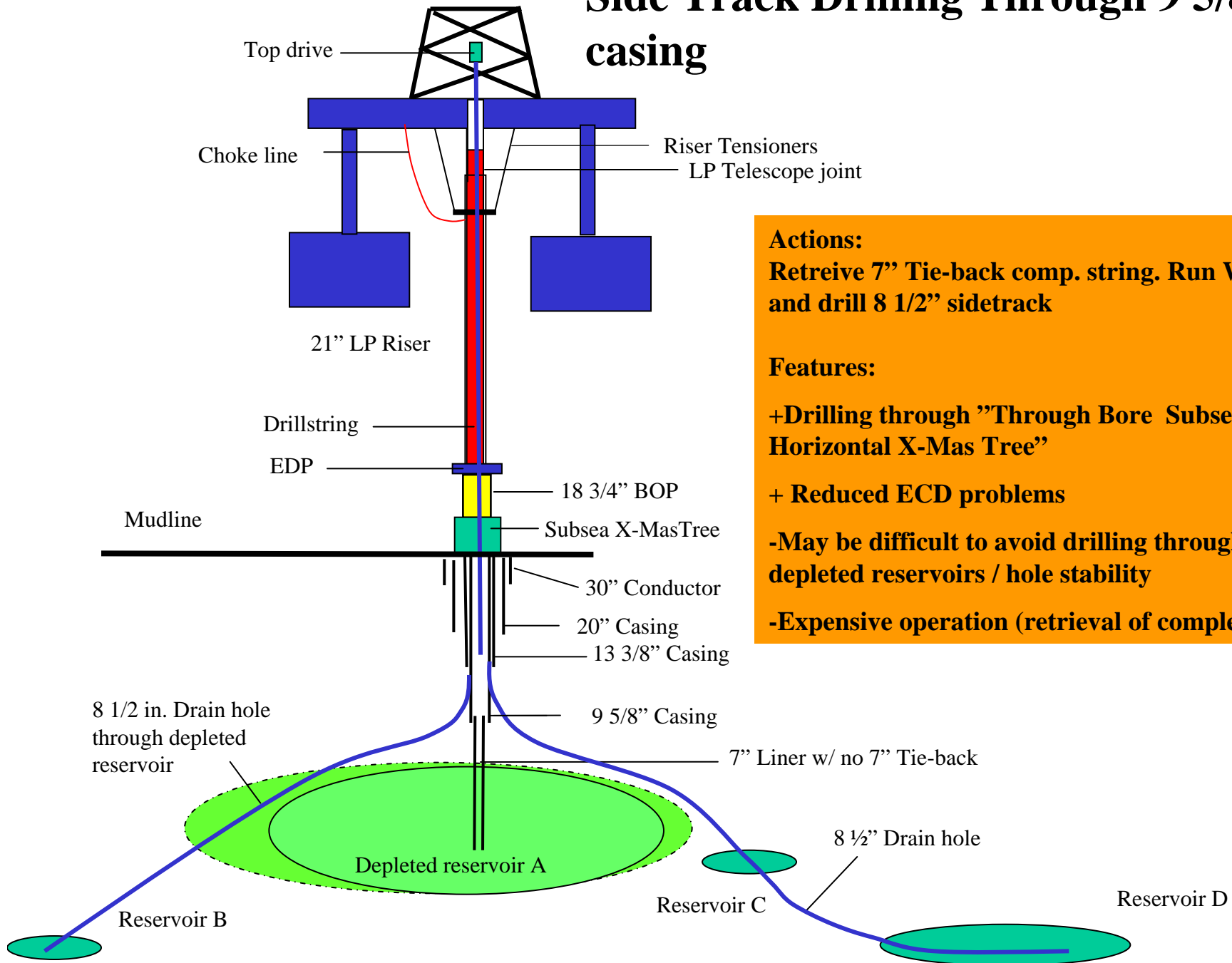
- + Lower specification vessel required
- + Acceptable regularity
- + Fast transit speed
- + Reduced Dayrate

Typical hook load capacity: 150 tonnes

Typical deck space 100 x 27 m

- Heavy workover cannot be performed, i.e., replacement of tubing string

Side Track Drilling Through 9 5/8" casing



Actions:

Retrieve 7" Tie-back comp. string. Run Wipstock and drill 8 1/2" sidetrack

Features:

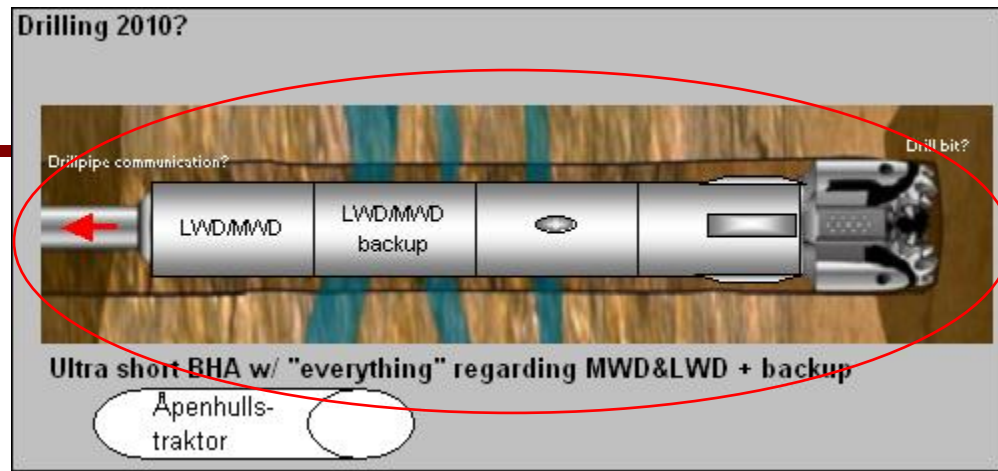
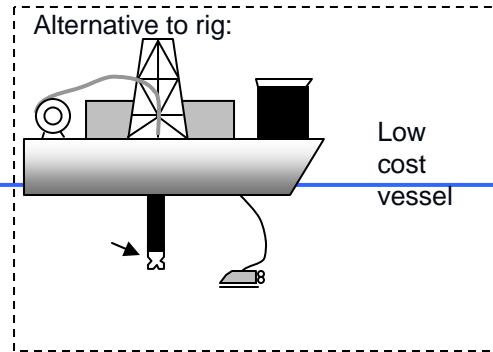
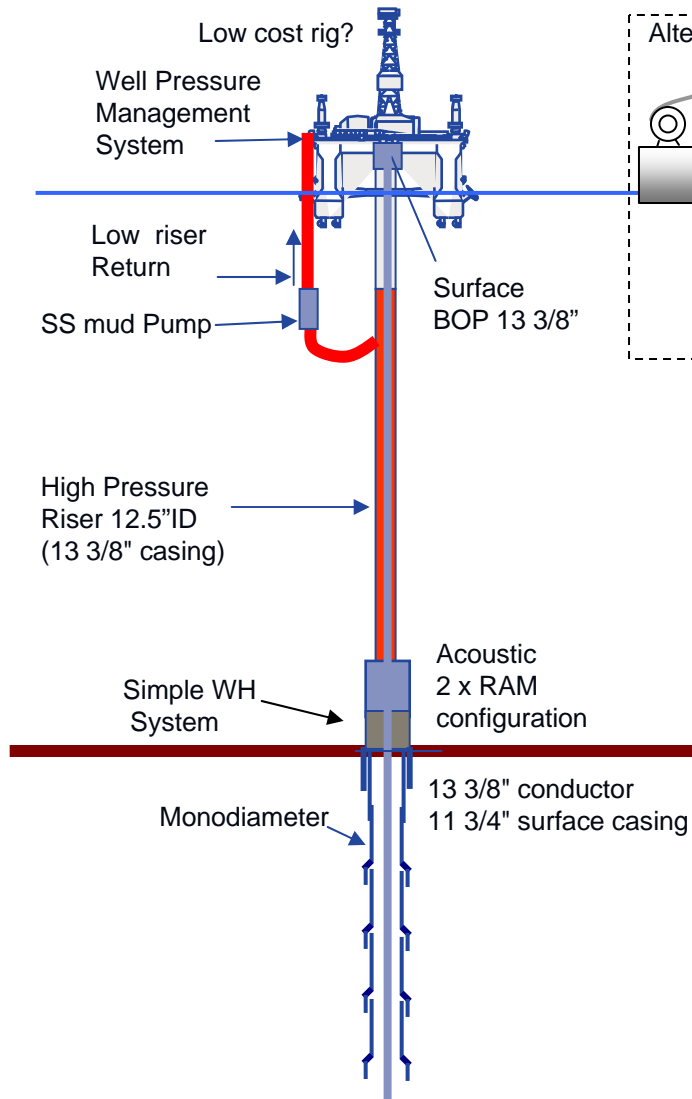
+Drilling through "Through Bore Subsea Horizontal X-Mas Tree"

+ Reduced ECD problems

-May be difficult to avoid drilling through depleted reservoirs / hole stability

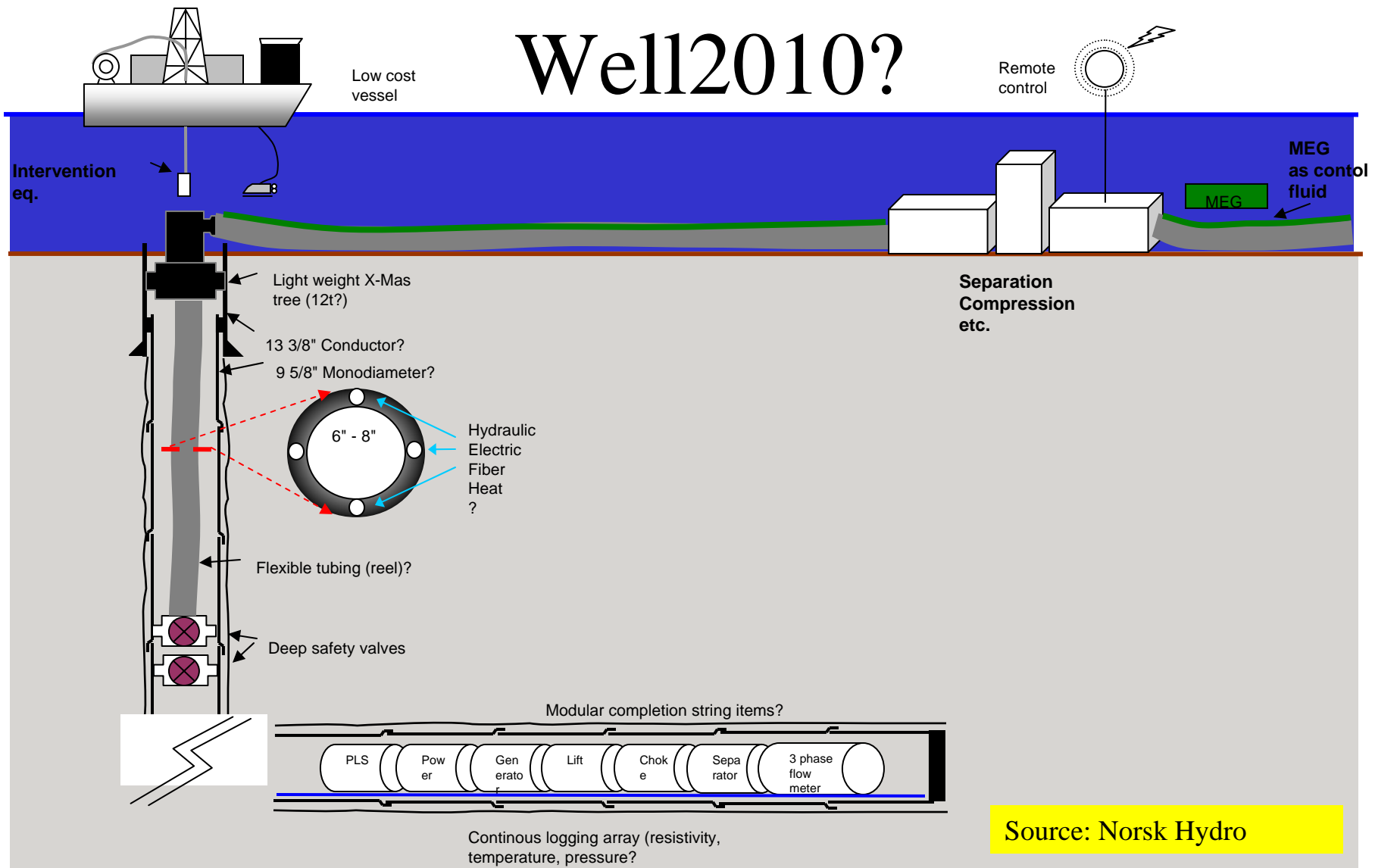
-Expensive operation (retrieval of completion)

Drilling 2010?



Source: Norsk Hydro

Well2010?



Source: Norsk Hydro

END OF PRESENTATION